

Remedial Action Pilot Study Report of Findings

**City of Arcata Corporation Yard
Arcata, California
Case No. 1NHU767**

Prepared for:

City of Arcata



Consulting Engineers & Geologists, Inc.

**812 W. Wabash
Eureka, CA 95501-2138
707/441-8855**

**May 2005
000108.100**



CONSULTING ENGINEERS & GEOLOGISTS, INC.

812 W. Wabash • Eureka, CA 95501-2138 • 707-441-8855 • Fax 707-441-8877 • info@shn-eureka.com

Reference: 000108.100

May 31, 2005

Kim Watson, Superintendent of Public Works
City of Arcata
736 F Street
Arcata, CA 95521

**Subject: Remedial Action Pilot Study Report of Findings, City of Arcata
Corporation Yard, 600 South G Street, Arcata, California; Case No.
1NHU767**


Dear Mr. Watson:

The attached report presents the results of the remedial action pilot study performed at the City of Arcata's Corporation Yard. Based on the results of this and previous site investigations, SHN Consulting Engineers & Geologists, Inc. recommends the installation of an air sparge system to remediate petroleum hydrocarbons in the soil and groundwater at the site.

Please call me if you have any questions or if I can help you in any way.

Sincerely,

SHN Consulting Engineers & Geologists, Inc.


Mike Foget, P.E.
Project Engineer
441-8855

MKF/COF:lms

Attachment: Air Sparge Report
copy w/attach: Steve Tyler, City of Arcata
Ron Allen, RWQCB
Melissa Martel, HCDEH

Reference: 000108.100

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600 South G Street
Arcata, California
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May 2005

QA/QC:JJA__



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Abbreviations and Acronyms

>	denotes a value that is “greater than” the method detection limits
in. H ₂ O	inches of water
ppm	parts per million
psi	pounds per square inch
scfm	standard cubic feet per minute
AS	Air Sparge
AST	Aboveground Storage Tank
B-#	Boring-#
BTEX	Benzene, Toluene, Ethylbenzene, and total Xylenes
CO ₂	Carbon Dioxide
LEL	Lower Explosion Limit
MSL	Mean Seal Level
MW-#	Monitoring Well-#
O ₂	Oxygen
S-#	Sump-#
SHN	SHN Consulting Engineers & Geologists, Inc.
TOC	Top of Casing
TPHD	Total Petroleum Hydrocarbons as Diesel
TPHG	Total Petroleum Hydrocarbons as Gasoline
VOC	Volatile Organic Compound

1.0 Introduction

This report presents the results of the remedial action pilot study conducted by SHN Consulting Engineers & Geologists, Inc. (SHN) at the City of Arcata Corporation Yard site. The site is located at 600 south G Street, Arcata, California.

1.1 Site Location and Description

The City of Arcata corporation yard is located on South G Street adjacent to Butcher's Slough and Arcata Bay. The corporation yard houses the City of Arcata wastewater treatment plant and the Department of Public Works vehicle maintenance and equipment storage facilities. The site lies within Section 32 of Township 5 North, Range 1 East, Humboldt Base and Meridian (Figure 1). The current site investigation is located near the former Aboveground Storage Tanks (ASTs), between the traffic control building and the material storage bins. A site plan of the subject site is included as Figure 2.

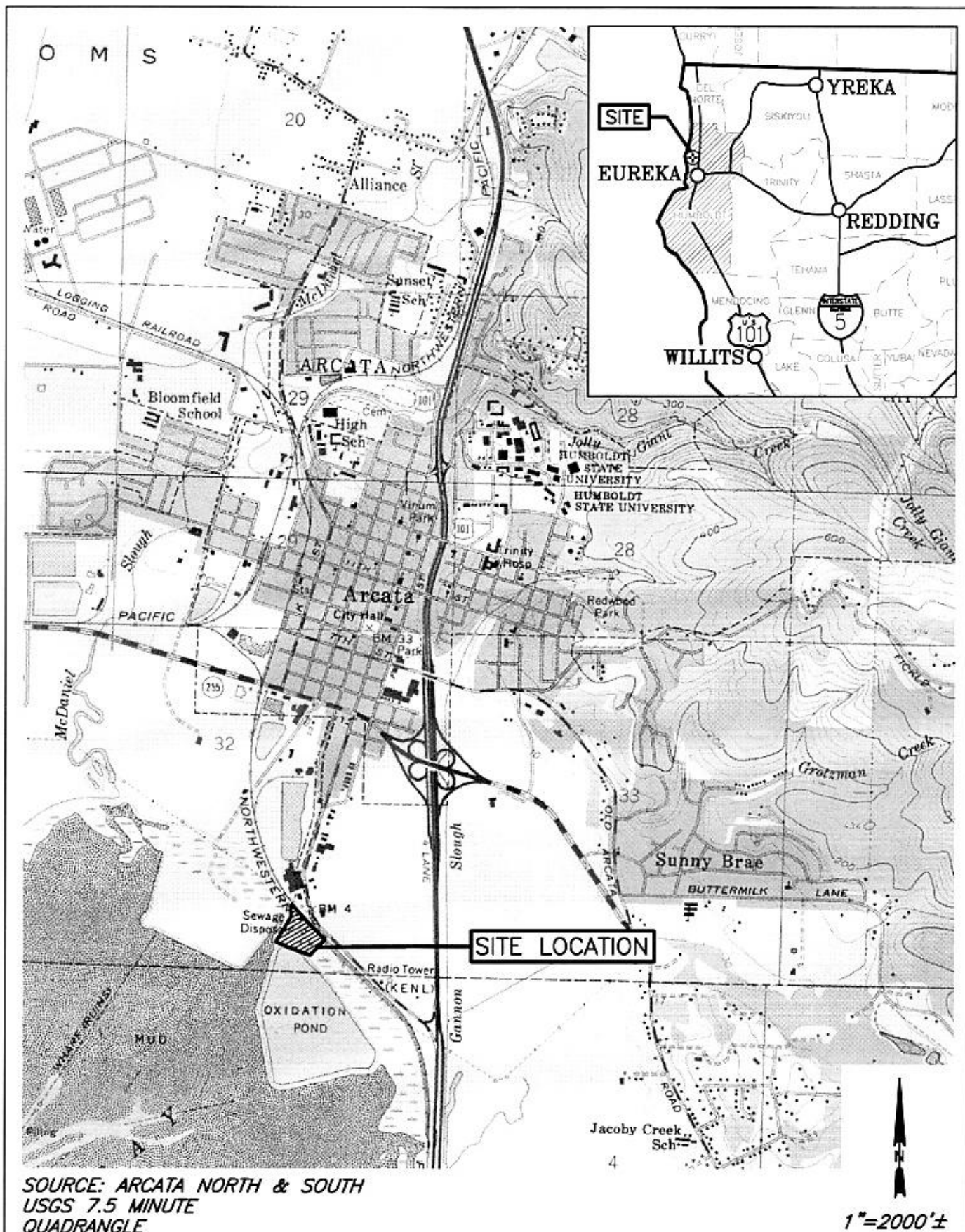
1.2 Background History

Background information for the site was obtained from the City of Arcata Environmental Services Department. Fueling activities commenced at the corporation yard in 1962. Aerial photographs taken in 1967 revealed ASTs, as well as a fueling island located south of the existing sign storage shop (in the vicinity of the new channel drain). The fueling island was moved between 1967 and 1989; although, the exact date has not been verified. Aerial photographs taken in 1989 revealed new ASTs and the relocated fueling island. The corporation yard was historically tidal marsh with drainage channels that were filled in over time. Prior to the City locating the corporation yard to this site, the land area near the former fueling island was used by the City for the disposal of soil generated from various construction and repair activities.

In 2000, the City of Arcata began upgrading their corporation yard. During the initial phase of the facility upgrade, contamination was encountered when a trench for a channel drain was being constructed. Free product and contaminated soils were noted in the portion of the trench located in the vicinity of the fuel island dispensers. A pressure test was conducted by W. N. Tetrault & Co. of Eureka, California on May 11, 2000, to determine which, if any, of the fuel lines were leaking. During the pressure test it was determined that the diesel line and the unleaded fuel line were both leaking. Following the results of the pressure test, the fuel island was immediately taken out of service by the City of Arcata.

In June 2000, SHN completed a subsurface investigation at the corporation yard site, to further define the extent of petroleum hydrocarbon contamination near the aboveground fuel tanks. Ten exploratory soil borings (B-1 through B-10) were installed by direct push technology using a truck-mounted Geoprobe®. Soil samples were collected from each boring location at various depths. The borings were then converted into temporary groundwater well points, which were used to assess the presence of contamination in groundwater beneath the site. Both the soil and groundwater samples were analyzed for Total Petroleum Hydrocarbons as Gasoline (TPHG) and as Diesel (TPHD); Benzene, Toluene, Ethylbenzene, and total Xylenes (BTEX); fuel oxygenates; and lead. Elevated concentrations of diesel, gasoline, and BTEX were present in the soil and groundwater samples that were collected near the fueling island.

In August 2000, SHN conducted an additional investigation at the corporation yard site, to further define the extent of petroleum hydrocarbon contamination in soil and groundwater. SHN's work



SH
Consulting Engineers
& Geologists, Inc.

City of Arcata Corp. Yard
600 South G Street
Arcata, California

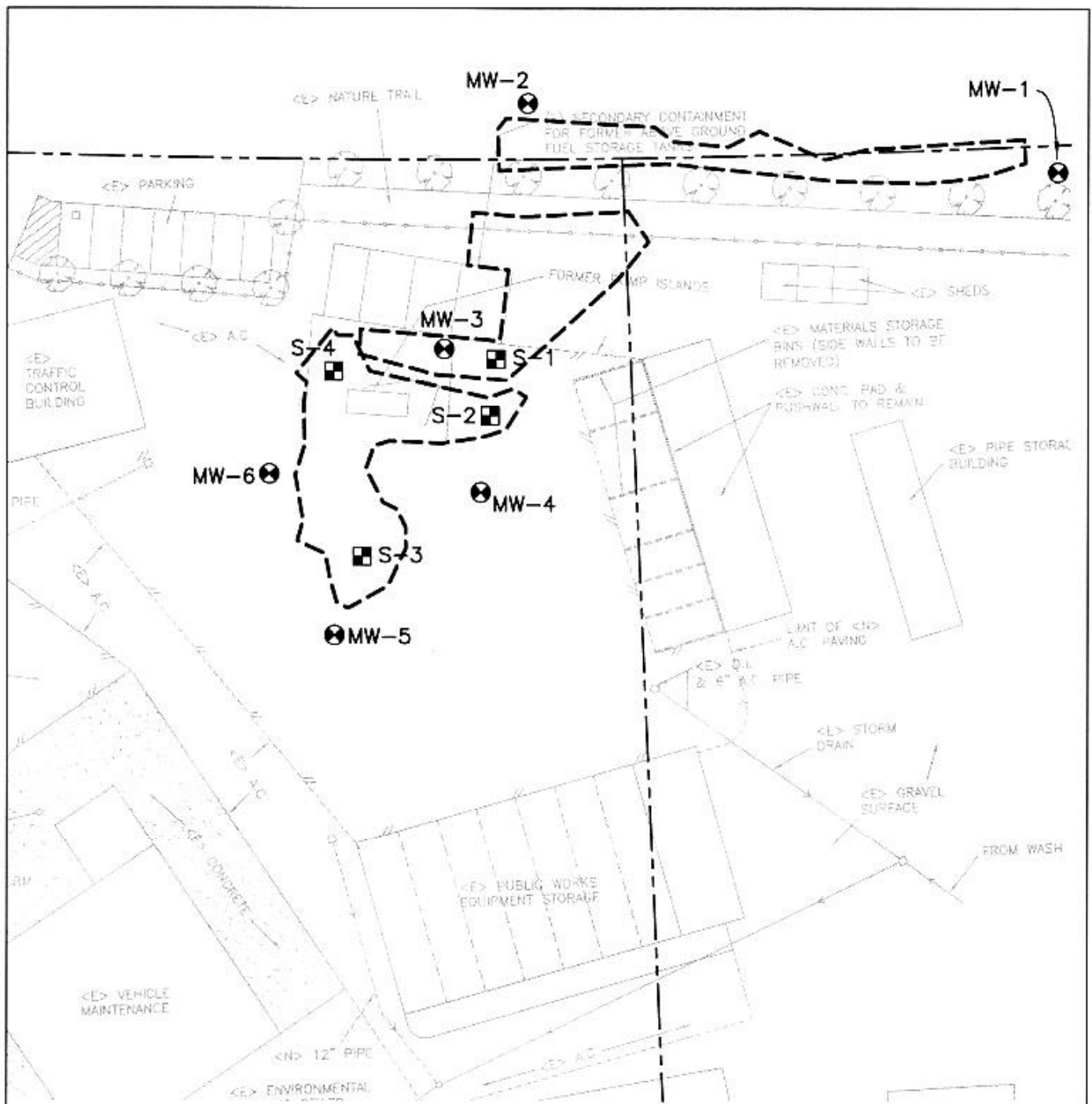
Site Location Map

SHN 000108.100

MAY 2005

000108.100-VIC-MAP

Figure 1



EXPLANATION

- MW-5 MONITORING WELL LOCATION AND DESIGNATION
- EXCAVATION AREAS
- S-4 SUMP LOCATION AND DESIGNATION

1"=40'±

SHN
Consulting Engineers
& Geologists, Inc.

City of Arcata Corp. Yard
600 South G Street
Arcata, California

Site Plan

SHN 000108.100

MAY 2005

000108.100-FIG-2

Figure 2

included the drilling of nine exploratory soil borings in the source area, and the installation of temporary well points. Follow-up investigation confirmed the presence of elevated concentrations of diesel, gasoline, and BTEX in soil in the area of the fueling island, and in groundwater near the source area.

Prior to the commencement of over-excavation and remedial activities at the site, between October 25 and 30, 2000, a release of an estimated 550 gallons of gasoline entered into a temporary fueling island containing the diesel and gasoline dispensers, and dispersed onto the surrounding area. An interim remedial measure included the excavation of an estimated 240 cubic yards of petroleum hydrocarbon-contaminated soils. Between October 4 and 9, 2001, an additional 500 cubic yards of soil were excavated from the source areas and stockpiled on site.

A groundwater pump and treat system was installed in May 2004 and has operated periodically. The total volume of groundwater removed from the former excavation is 950 gallons. SHN determined that the pump and treat system has had minimal effect on decreasing petroleum hydrocarbon concentrations in the groundwater and the pump and treat system was taken off-line during March 2005.

A summary of well construction details is presented in Table 1.

<p style="text-align: center;">Table 1 Well Construction Details City of Arcata Corporation Yard, Arcata, California</p>							
ID	Date Completed	Total Depth (feet)	Screen Interval (feet)	Sand Interval (feet)	Well Diameter (inches)	TOC (feet, MSL¹)	Gravel Fill Interval
MW-1	9/18/02	15	5-15	4-15	2	8.73	0-2
MW-2	9/18/02	15	5-15	4-15	2	9.86	0-4
MW-3	9/19/02	15	5-15	4-15	2	6.97	0-7.5
MW-4	9/19/02	15	5-15	4-15	2	6.96	0-3.5
MW-5	9/19/02	15	5-15	4-15	2	6.83	0-5
MW-6	9/19/02	15	5-15	4-15	2	6.73	0-4
1. MSL: Mean Sea Level							

2.0 Objective

The objective of the pilot test was to perform an air sparge test in the excavation backfill to determine its suitability as a remedial action and estimate an effective radius of influence.

3.0 Field Activities--Air Sparge Pilot Test

On April 29, 2005, SHN conducted an Air Sparge (AS) pilot test in well S-1. The goals of the AS pilot test were to:

1. Estimate the airflow rates and the corresponding backpressures.
2. Estimate the zone of influence of air sparging.
3. Observe changes of the groundwater elevation of selected monitoring wells.
4. Observe chemical parameter changes in the soil vapor of selected monitoring wells.

The construction of sump S-1 consists of a 6-inch, solid, polyvinyl chloride riser pipe from the well vault to the bottom of the excavation, which is at approximately 7-feet below ground surface. The bottom end of the riser pipe is connected to perforated lateral piping that extends through out the excavation. Sumps S-2 thru S-4 were constructed in a similar fashion; each sump connects to the lateral piping at the bottom of the excavation.

Prior to initiating the AS pilot test, an initial baseline measurement of pressure/vacuum, water levels, percent combustible gases, percent carbon dioxide, and percent oxygen at selected monitoring wells were collected.

4.0 Results of the Investigation--Air Sparge Testing

The AS pilot test, conducted on April 29, 2005, included injecting air into the groundwater at the well S-1 using an air compressor and filter/flow regulation equipment. The test was run at three different flow rates (10, 20, and 25 standard cubic feet per minute [scfm]) for approximately 1-hour at each flow rate. During the test, the sparge well injection airflow rate, injection pressure, and duration were measured. Water levels of the monitoring wells were recorded prior to and after the air sparge test. The air sparging radius-of-influence was determined by monitoring pressure in the adjacent wells during the test using magnahelic pressure gauges. Vadose zone Volatile Organic Vapors (VOC), oxygen, and carbon dioxide concentrations were also measured in the monitoring wells. All data collected was recorded and is included in Appendix A.

The depth to groundwater of the monitoring wells before and after the air sparge pilot test are presented in Table 2.

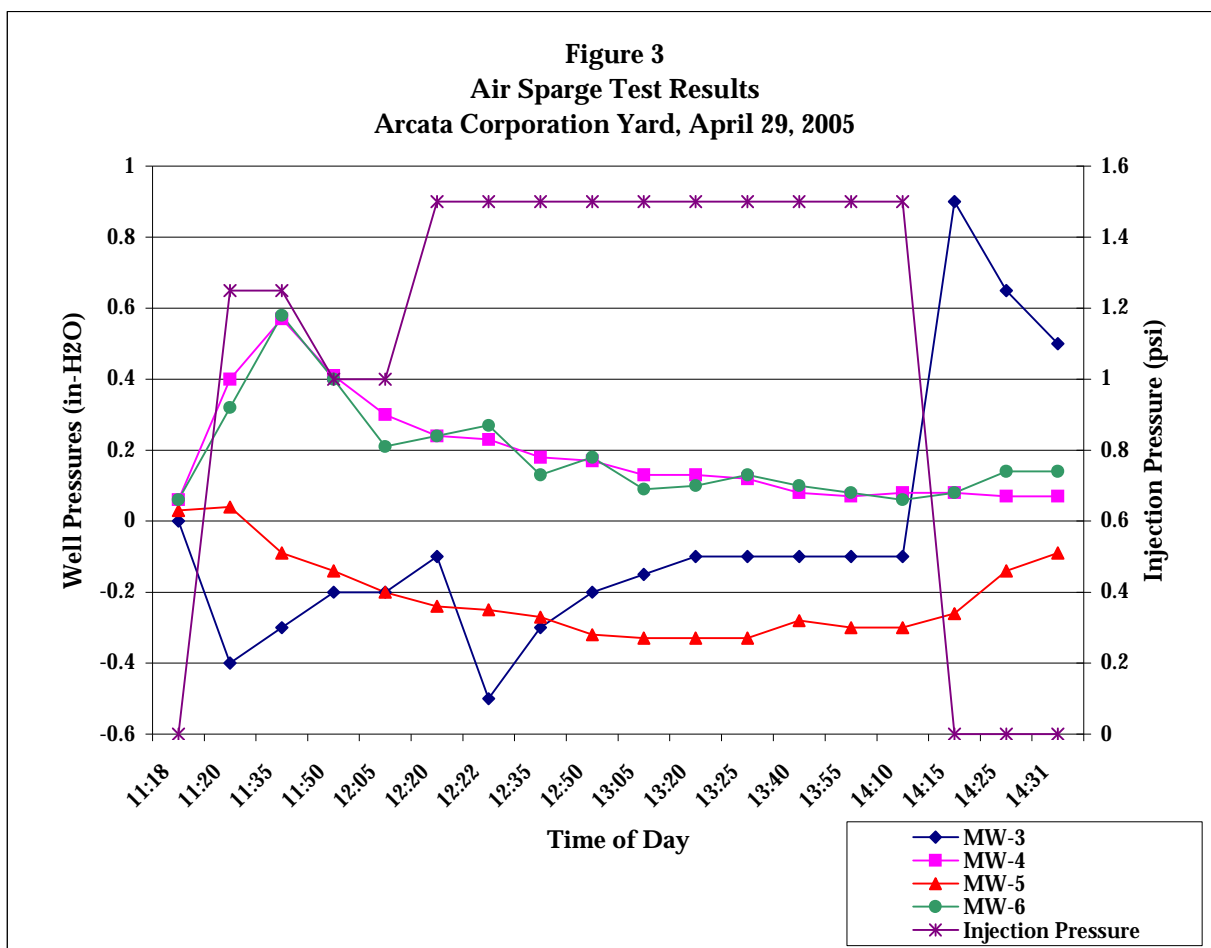
Table 2 Depth to Water Data, AS Pilot Test, April 29, 2005 City of Arcata Corporation Yard, Arcata, California				
Well ID	MW-3	MW-4	MW-5	MW-6
Distance from S-1 (feet)	14.3	38.5	90.5	71.5
Initial Depth to Groundwater 10:45 am (feet from TOC¹)	1.40	2.82	1.28	1.82
Final Depth to Groundwater 3:00 pm (feet from TOC)	1.40	1.96	1.30	1.56
1. TOC: Top of Casing				

The soil vapor concentrations for VOCs, Oxygen (O₂), and Carbon Dioxide (CO₂) of the selected monitoring wells were recorded before and after the air sparge pilot test and the results are presented in Table 3.

<p align="center">Table 3 Soil Vapor Data, AS Pilot Test, April 29, 2005 City of Arcata Corporation Yard, Arcata, California</p>						
Well ID	Concentrations ¹					
	Before AS Pilot Test			After AS Pilot Test		
	VOC ² (ppm) ³	O ₂ ⁴ (%)	CO ₂ ⁵ (%)	VOC (ppm)	O ₂ (%)	CO ₂ (%)
MW-3	20	20.9	0.1	20	20.8	0.1
MW-4	4,400	6.8	10.2	69% LEL ⁶	11.2	17.0
MW-5	220	20.1	2.6	100	20.9	0.4
MW-6	55% LEL	10.0	>20.0 ⁷	3,200	13.2	3.5
<p>1. Concentrations measured using GasTech® Meter (self calibrated) 5. CO₂: Carbon Dioxide 2. VOC: Volatile Organic Compounds 6. LEL: Lower Explosion Limit (1 LEL = approximately 700 ppm) 3. ppm: parts per million 7. >: denotes a value that is "greater than" the method detection limits 4. O₂: Oxygen</p>						

The vapor pressures of the selected monitoring wells were recorded during the injection of air into S-1. The airflow into sump S-1 and the pressure required to maintain the desired flow rate was recorded. The distances from sump S-1 to the monitoring wells were also recorded. The injection flow rate, injection pressure, adjacent well pressures, and distances to sump S-1 are presented in Table 4 and Figure 3.

<p align="center">Table 4 AS Pilot Test Data, S-1, April 29, 2005 City of Arcata Corporation Yard, Arcata, California</p>						
Time	Sparge Well SP-1		Pressure in Selected Wells (in. H ₂ O) ³ (distance from SP-1 [source well] in feet)			
	Flow (scfm) ¹	Pressure (psi) ²	MW-3 [14.3]	MW-4 [38.5]	MW-5 [90.5]	MW-6 [71.5]
11:18	0.0	0.0	0.0	0.06	0.03	0.06
11:20	10	1.25	-0.4	0.40	0.04	0.32
11:35	10	1.25	-0.3	0.57	-0.09	0.58
11:50	10	1.0	-0.2	0.41	-0.14	0.40
12:05	10	1.0	-0.2	0.30	-0.20	0.21
12:20	10	1.5	-0.1	0.24	-0.24	0.24
12:22	20	1.5	-0.5	0.23	-0.25	0.27
12:35	20	1.5	-0.3	0.18	-0.27	0.13
12:50	20	1.5	-0.2	0.17	-0.32	0.18
13:05	20	1.5	-0.15	0.13	-0.33	0.09
13:20	20	1.5	-0.10	0.13	-0.33	0.10
13:25	28	1.5	-0.10	0.12	-0.33	0.13
13:40 ⁴	25	1.5	-0.10	0.08	-0.28	0.10
13:55	25	1.5	-0.10	0.07	-0.30	0.08
14:10	25	1.5	-0.10	0.08	-0.30	0.06
14:15	0	0.0	0.9	0.08	-0.26	0.08
14:25	0	0.0	0.65	0.07	-0.14	0.14
14:31	0	0.0	0.5	0.07	-0.09	0.14
<p>1. SCFM: Standard Cubic Feet per Minute 3. in. H₂O: inches of water 2. psi: pounds per square inch 4. Injection of air was interrupted for approximately 2 minutes at 13:38</p>						



5.0 Discussion

The following findings are based on the information previously presented:

- The radius of influence for air sparging at sump S-1 has been determined to be approximately the full extent of the historical excavation, extending outward toward MW-3 and MW-6. Although MW-3 is closest to sump S-1, it had the least influence.
- The air sparge tests conducted on sump S-1 determined that the well construction and backfill appears to be suited for air sparging.
- The backfill of the excavation is highly permeable to air, as is demonstrated by the low injection pressures required to maintain the airflow rates.

6.0 Conclusions and Recommendations

Based on the findings of the pilot air sparge test, SHN recommends the installation of an air sparge system to remediate the petroleum hydrocarbons in the groundwater and soils at the site. All of the existing sumps (S-1 thru S-4) shall be connected to a blower and associated control plumbing. A Process and Instrumentation Diagram is included in Appendix B.

**ENGINEERS & GEOLOGISTS**812 W. Wabash Ave.
Eureka, CA 95501-2138Tel. 707 / 441-8855
Fax: 707 / 441-8877

JOB Arcata Corp Yard - 000108.mcd
 SHEET NO. 1 OF 3
 CALCULATED BY C. Fisher DATE 29th Apr 05
 CHECKED BY _____ DATE _____
 SCALE _____

- Arr. Site @ 10:00
- Opening monitoring wells MW-3, 4, 5, 6
- Sampling well casing vapors @ 10:20

Well	VOC	O ₂	CO ₂
MW-3	20 PPM	20.9	0.1
MW-4	4400 PPM	6.8	10.2
MW-5	720 PPM	20.1	2.6
MW-6	550% LA	10.0	>20

- Measuring depth to water from TOC

Well	DTW	DTW AFTER TEST
MW-3	1.4 FT	1.4 FT
MW-4	2.82 FT	1.96 FT
MW-5	1.28 FT	1.30 FT
MW-6	1.82 FT	1.56 FT

- Installed extraction caps on MW-3, 4, 5, 6
 ↳ See next sheet for Air Spurge pressures

- Vapor readings @ edge of equipment building @ 11:26
 VOC = 150 PPM O₂ = 20.9% CO₂ = 0.3%

- MW-6 & MW-4 had slight pressure rise due to rising water in the well casing.

- No leakage of air around well seal of S-1 @ 12:00

- VAPOR READING AT EDGE OF EQUIPMENT BUILDING @ 12:00
 VOC = 0 PPM , O₂ = 20.9% , CO₂ = 0%

- VAPOR READING @ EDGE OF EQUIPMENT SHOP @ 2:00
 VOC = 40 PPM , O₂ = 20.9 , CO₂ = 0.2%

**ENGINEERS & GEOLOGISTS**812 W. Wabash Ave.
Eureka, CA 95501-2138Tel: 707 / 441-8855
Fax: 707 / 441-8877

JOB Arcata Corp Yard - 000108.100
 SHEET NO. 2 OF 3
 CALCULATED BY C. Fisher DATE 29 Apr '05
 CHECKED BY _____ DATE _____
 SCALE _____

Air Sparge Test - Arcata Corp Yard

Inj. well - S-1

<u>Time</u>	<u>Flow</u>	<u>Pressure</u>	<u>MW-3</u>	<u>MW-4</u>	<u>MW-5</u>	<u>MW-6</u>
11:18	Ø	Ø	0	0.06	0.03	0.06
11:20	10 CFM	1.25 PSI	-0.4	0.40	0.04	0.32
11:35	10 CFM	1.25 PSI	-0.3	0.57	-0.09	0.58
11:50	10 CFM	1.0 PSI	-0.2	0.41	-0.14	0.40
12:05	10 CFM	1.0 PSI	-0.2	0.30	-0.20	0.21
12:20	10 CFM	1.5 PSI	-0.1	0.24	-0.24	0.24
12:22	20 CFM	1.5 PSI	-0.5	0.23	-0.25	0.27
12:35	20 CFM	1.5 PSI	-0.3	0.18	-0.27	0.13
12:50	20 CFM	1.5 PSI	-0.2	0.17	-0.32	0.18
1:05	20 CFM	1.5 PSI	-0.15	0.13	-0.33	0.09
1:20	20 CFM	1.5 PSI	-0.10	0.13	-0.33	0.10
1:25	28 CFM	1.5 PSI	-0.10	0.12	-0.33	0.13
* 1:38	25 CFM	1.5 PSI	SYSTEM SHUT DOWN FOR APPROX 2 min.			
1:40	25 CFM	1.5 PSI	-0.10	0.08	-0.28	0.10
1:55	25 CFM	1.5 PSI	-0.10	0.07	-0.30	0.08
2:10	25 SCFM	1.5 PSI	-0.10	0.08	-0.30	0.06
<u>SYSTEM OFF</u>						
2:15	Ø	Ø	0.9	0.08	-0.26	0.08
2:25	Ø	Ø	0.65	0.07	-0.14	0.14
2:31	Ø	Ø	0.5	0.07	-0.09	0.14

**ENGINEERS & GEOLOGISTS**812 W. Wabash Ave.
Eureka, CA 95501-2138Tel. 707 / 441-8855
Fax: 707 / 441-8877JOB Hercules Corp Yard - 000102.100
SHEET NO 3 OF 3
CALCULATED BY C. Fisher DATE 29th Apr 05
CHECKED BY _____ DATE _____
SCALE _____

DISTANCE FROM INJECTION S-1 TO:

MN3 = 14.3 ft

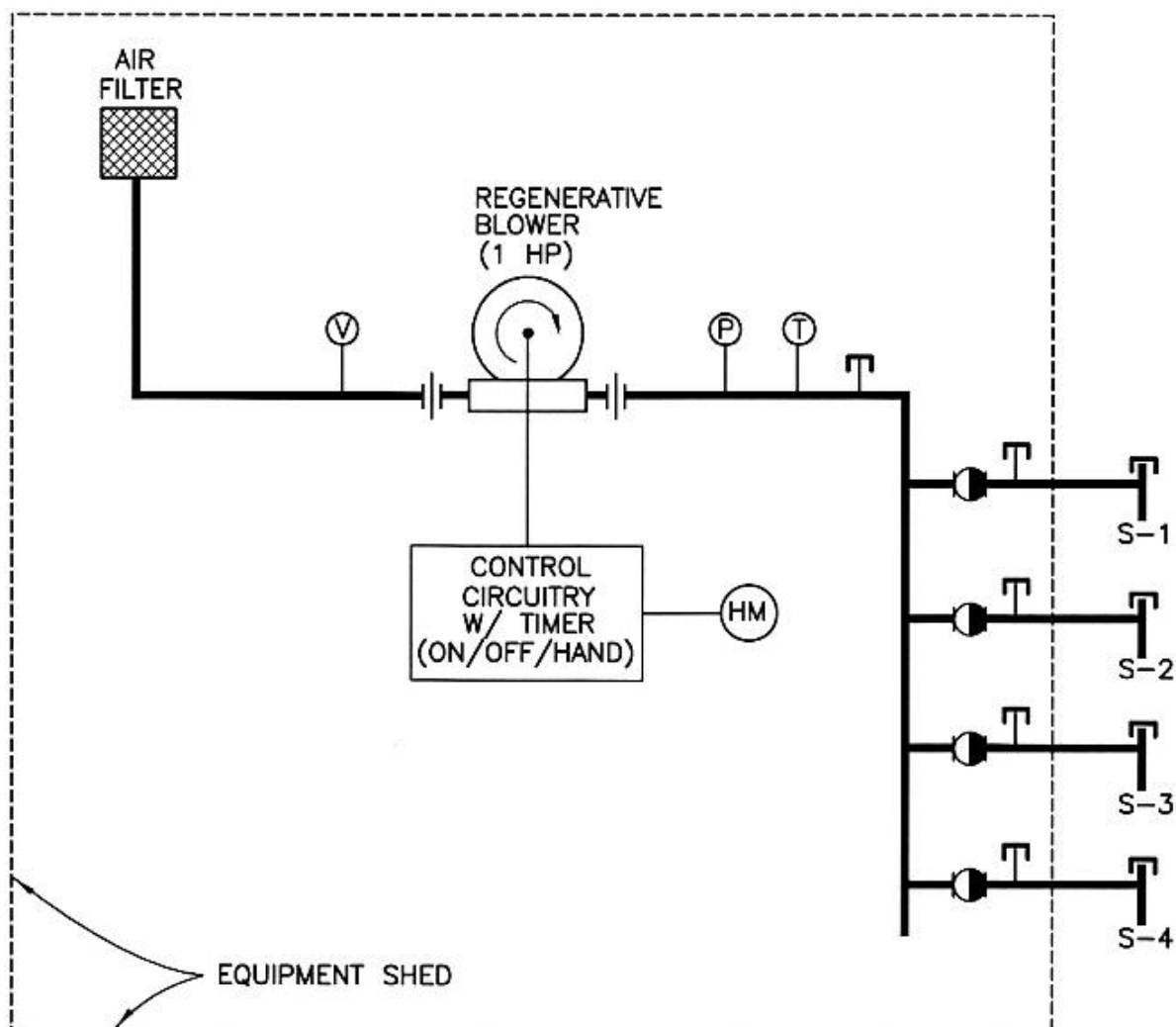
MN6 = 71.5 ft

MNS = 90.5 ft

MN4 = 38.5 ft

- SAMPLE WELL GASING VAPORS @ 2. PM

<u>WELL</u>	<u>VOC</u>	<u>O₂</u>	<u>CO₂</u>
MN-3	20 PPM	20.8%	0.1%
MN-4	69% LEL	11.2%	17.0%
MN-5	100 PPM	20.9%	0.4%
MN-6	3200 PPM	13.2%	3.5%



EXPLANATION

SAMPLE PORT	PRESSURE GAUGE
BALL VALVE	TEMPERATURE GAUGE
UNION	HOUR METER
VACUUM GAUGE	